Bone Mineral Density Measurements of Adult Males in Mersin: Comparison of Lumbar Spine and Femur

Mersin'de Yetişkin Erkeklerde Kemik Yoğunluğu Ölçümleri: Lomber Vertebra ve Femur Karşılaştırması

Comparison of Lumbar/Femoral BMD in Men

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Özet

Amaç: Geriatrik ve geriatrik olmayan yetişkin erkek populasyonundaki lomber ve femur boynu kemik mineral yoğunluğu (KMY) değerlerini karşılaştırmayı, her iki yaş grubunda bu iki anatomik bölgenin KMY değerleri arasındaki korelasyonu, uyumu ve uyumsuzluğu bulmayı amaçladık. Gereç ve Yöntem: Çalışmamıza dahil edilen 240 yetişkin erkek, geriatrik (n=126) ve geriatrik olmayan gruplar (n=114) halinde ikiye ayrıldı. Lomber vertebraların (L1-4) ve sol femur boynunun dual-enerji X-ışını absorpsiyometri (DXA) yöntemi ile ölçümleri yapıldı. Uyum, minör ve majör uyumsuzluk oranları belirlendi. Bu iki yaş grubunun KMY değerleri karşılaştırıldı. Her iki yaş grubundaki lomber ve femoral bölgelerin KMY değerleri arasındaki korelasyon hesaplandı. Bulgular: Geriatrik erkeklerin KMY ortalamaları geriatrik olmayanlarınkinden anlamlı derecede düşüktü (p<0.05). Her iki gruptaki L1-4 ve femur boynu T-skorları arasında anlamlı korelasyon mevcuttu (p<0.05). Geriatrik erkek grubunda, T-skorları arasındaki uyum, minör ve majör uyumsuzluk sırasıyla %51.6, %42.8 ve %5.6 oranında bulundu. Geriatrik olmayan erkek grubunda, T-skorları arasındaki uyum, minör ve majör uyumsuzluk oranları sırasıyla 61.4%, 35.1% and 3.5% bulundu. Tartışma: DXA yöntemi, geriatrik ve geriatrik olmayan yetişkin erkeklerin KMY'lerini karşılaştırmada yararlı bulundu. L1-4 ve femur boynu T-skorları arasındaki korelasyon hem geriatrik hem de geriatrik olmayan yetişkin erkeklerde anlamlı bulunmuş olmakla beraber, hastaların DXA sonuçlarını değerlendirirken minör ve majör uyumsuzluklar dikkate alınmalıdır.

Anahtar Kelimeler

Absorpsiyometri; Foton-Kemik Mineral Dansitesi-Geriatri-Femur Boynu-Lumbar Vertebra

Abstract

Aim: We aimed to compare lumbar and femoral neck bone mineral density (BMD) values of geriatric and non-geriatric adult male populations, to find the correlation and the rates of concordance-discordance between BMD values of these two anatomic regions within both age groups. Material and Method: Two hundred and forty men were recruited and divided into two groups, geriatric (n=126) and non-geriatric (n=114). Lumbar spine (L1-4) and left femoral neck BMD were measured using dual-energy x-ray absorptiometry (DXA). Concordance, minor, and major discordance rates were determined. BMD values of these two age groups were compared. The correlations between BMD values of lumbar and femoral regions within both age groups were calculated. Results: The mean BMD of geriatric men was significantly lower than that of non-geriatric men (p<0.05). The correlation between T-scores of L1-4 and femoral neck was significant in both groups (p<0.05). In the geriatric group, the concordance, minor, and major discordance rates of T-scores were found as 51.6%, 42.8%, and 5.6%, respectively. In the non-geriatric group, the concordance, minor, and major discordance rates of T-scores were found as 61.4%, 35.1%, and 3.5%, respectively. Discussion: DXA was useful in comparing BMD of geriatric and non-geriatric men. Though the correlation between T-scores of L1-4 and femoral neck was found to be significant both in geriatric and non-geriatric men, minor or major discordances between these regions should be taken into consideration while evaluating DXA results of the patients.

Keywords

Absorptiometry; Photon-Bone Mineral Density-Geriatrics-Femur Neck-Lumbar Vertebrae

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Introduction

Osteoporosis is characterized by low bone mass and micro-architectural deterioration which is responsible for increased risk of bone fracture [1]. Altough osteoporosis is an important health problem in men as in women, it can be underestimated and undertreated [2]. Bone mineral density (BMD) is influenced by many factors such as ethnicity, gender, age, location, eating habits, and lifestyle [3]. Individuals of 65 years of age or older are included in the geriatric age group [4]. It was reported that the incidence of fractures in men increases particularly after the age of 75 years [5]. High-density structures at either the lumbar or femoral neck regions, such as soft tissue calcification, metallic objects, contrast media, osteoarthritis, etc., can result in wrong BMD measurements [6]. In these situations, the unaffected lumbar or femoral neck region gains the utmost significance for determination of osteroporosis. In this cross-sectional study which we performed in a Mediterrenean city (Mersin) of Turkey, we aimed to determine lumbar and femoral neck BMD values of geriatric and younger adult male populations, to compare BMD values of these two age groups, and to find the correlation, concordance, and discordance rates between the BMD values of these two main anatomic regions within both age groups.

Material and Method

Patient selection and obtaining patient data

In this prospective study, a total of 257 consecutive male individuals who did not have major risk factors that might affect bone mass and who underwent BMD evaluation as a routine outpatient procedure were recruited from 2010 to 2013. Patients with internal metallic fixators in their lumbar vertebrae (n=2), patients with BMD measurements of only the proximal femoral or lumbar regions (n=6), patients with only total body BMD measurements (n=3), and pediatric male patients (n=6) were excluded. The remaining adult males (n=240) were included and divided into two groups with respect to their ages. Those over 65 years of age (n=126) were included in the geriatric male group, while adult males under 65 years of age (n=114) were included in the non-geriatric male group. In both groups, patients were not taking any medication affecting bone metabolism (calcium, certain diuretics, estrogens, corticosteroids, anticonvulsants, vitamin D, heparin, etc.). All of the procedures were performed according to the World Medical Association Declaration of Helsinki (revised in 2000, Edinburgh). All the patients were informed about dual-energy x-ray absorptiometry (DXA) examination and informed consent was obtained from them. The mean ages of the geriatric and the non-geriatric male groups were 72.83±5.19 and 50.4±11.1 years, respectively. Weight, height and age of the patients were recorded at the time of BMD measurement. Body mass index (BMI) was calculated using the following formula: weight (kg)/height(m)^2 [7]. According to the mean value of BMI, which was 26.42±5.41 for the geriatric male group and 28.03±5.32 for the non-geriatric group, the overall weight status of the patients was determined as overweight [7].

Bone Mineral Density Measurement

In each patient, the lumbar spine (L1-4) BMD and left femoral neck BMD were measured by experienced technicians using a DXA device (Lunar Prodigy Advance; GE Medical Systems-Lunar, Madison, WI, USA). Daily quality control was carried out by measurement of an approved phantom. L1-4 measurements were done in the supine position with the legs elevated and supported below the knees to decrease lumbar lordosis. Femoral neck measurements were also performed in the supine position and femoral anteversion was corrected by rotating the foot internally. The BMD of the patients was defined as g/cm^2 and evaluated by using T-score (standard deviation of healthy young-adult mean) [8]. The World Health Organization (WHO) classification system was used; it defines normal BMD as T-score ≥ -1.0, osteopenia as T-score between -2.5 and -1, and osteoporosis as T-score ≤ -2.5 [1, 5, 8]. Concordance was described as obtaining lumbar and femoral T-scores that are in the same range of normal, osteopenic or osteoporotic. Minor discordance was described as having only one WHO diagnostic class difference between the lumbar and femoral regions, such as a normal T-score in one region and an osteopenic score in the other, or an osteopenic T-score in one region and an osteoporotic score in the other. Major discordance was described as detection of osteoporosis in one region when the other region was normal [9–11].

Statistical Analysis

The mean, standard deviation, and 95% confidence interval (CI) were calculated for all the quantitative variables. The frequencies of the patients with osteoporosis, osteopenia and normal BMD were expressed as percentages. The student t-test was used to determine whether there was a statistically significant difference between the geriatric and non-geriatric groups for the parameters (BMD, T-scores, BMI, age) measured. Within each group the Pearson correlation test was used to evaluate the relationship between T-scores of L1-4 and femoral neck. Also within each group, the Pearson correlation test was used to evaluate the relationship between BMI and all BMD measurements of L1-4 and femoral neck. P values < 0.05 were considered as statistically significant. All analyses were done with SPSS software (version 16.0: SPSS Inc, Chicago, IL).

Results

The mean BMI and BMD measurements in the geriatric group were significantly lower than those of the non-geriatric group ($p<0.05$) (Table 1). According to T-scores of L1-4, the percentage of osteoporosis in the geriatric and non-geriatric groups was 38% and 11.4%, respectively. According to T-scores of femoral neck, the percentage of osteoporosis in the geriatric and non-geriatric groups was 41.3% and 6.2%, respectively (Table 2a,b). The correlation between T-scores of L1-4 and femoral neck was significant both in the geriatric (r=0.560, p=0.000) and the non-geriatric (r=0.535, p=0.000) groups. In the geriatric group, concordance, minor discordance, and major discordance of T-scores were detected in 51.6% (n=65/126), 42.8% (n=54/126), and 5.6% (n=7/126) of the patients, respectively. In the non-geriatric group, concordance, minor discordance, and major discordance of T-scores were detected in 61.4% (n=70/114), 35.1% (n=40/114), and 3.5% (n=4/114) of the patients, respectively. The percentages of the regions that

Table 1. The mean BMI and BMD measurements with standard deviations in geriatric and non-geriatric male groups

	Geriatric male group (n=126)	Non-geriatric male group (n=114)	P value
L1-4 (g/cm²)	1.006±0.207	1.124±0.169	P=0.000
	(%95 CI: 0.970–1.043)	(%95 CI: 1.093–1.156)	
L1-4 (T-score)	-1.90±1.59	-0.96±1.31	P=0.000
	(%95 CI: -2.18– -1.61)	(%95 CI: -1.21– -0.72)	
Femur neck (g/cm²)	0.788±0.138	0.937±0.145	P=0.000
	(%95 CI: 0.763–0.812)	(%95 CI: 0.910–0.964)	
Femur neck (T-score)	-2.16±1.06	-1.03±1.09	P=0.000
	(%95 CI: -2.35– -1.97)	(%95 CI: -1.24– -0.83)	
BMI	26.42±5.41	28.03±5.32	P=0.000
	(%95 CI: 25.46–27.37)	(%95 CI: 27.05–29.02)	
Age (years)	72.83±5.19	50.4±11.1	P=0.000

*P values <0.05 are considered as statistically significant. BMI: Body mass index

Table 2. The percentages of the patients with normal BMD, osteopenia and osteoporosis in geriatric and non-geriatric male groups, according to T-scores of L1-4 (a) and femoral neck (b).

a.	T-score category of L1-4 in geriatric group (%, n)	T-score category of L1-4 in non-geriatric group (%, n)
Normal	24.6%	47.3%
(T-score ≥ -1.0)	(n=31/126)	(n=54/114)
Osteopenia	37.3%	41.2%
(-1.0 >T-score >-2.5)	(n=47/126)	(n=47/114
Osteoporosis	38%	11.4%
(T-score ≤ -2.5	(n=48/126)	(n=13/114)

b.	T-score category of femoral neck in geriatric group (%, n)	T-score category of femoral neck in non-geriatric group (%, n)
Normal	12.7%	48.2%
(T-score ≥ -1.0)	(n=16/126)	(n=55/114)
Osteopenia	46%	45.6%
(-1.0 >T-score >-2.5)	(n=58/126)	(n=52/114)
Osteoporosis	41.3%	6.2%
(T-score ≤ -2.5)	(n=52/126)	(n=7/114)

had lower T-scores in minor and major discordance are given in Table 3 for the geriatric and non-geriatric groups. In both the geriatric and non-geriatric groups, the correlations between the BMI and T-scores of L1-4 and femoral neck were statistically significant (p<0.05) (Table 4).

Discussion

For measuring BMD, today's most widely used and most precise technique is DXA, which is a quantitative digital radiography with a precision of 1-2% [8]. In a study including 3469 patients, the incidence of vertebral fractures was found to increase twofold for every 1 SD decrease in lumbar or femoral neck BMD values [12]. Femoral neck BMD measurement with DXA was determined as a strong predictor of hip fractures [13]. Diagnosis of osteoporosis, estimation of fracture risk, and follow-up of patients under treatment can accurately be done by DXA [1].

As the results of previous studies [14–17] and those of our study show, aging seems to have a great impact on BMD. In a large-scale study including 820 elderly men, the risk of multiple fractures in men older than 75 years was found to be about five times more than that of men who were between 60-64 years of

Table 3. The percentages of the regions which had lower T-scores in minor and major discordance given for geriatric and non-geriatric male groups.

	Minor Discordance		Major Discordance	
	L1-4	Femoral neck	L1-4	Femoral neck
% of regions with lower	44.4%	55.6%	0%	100%
T-scores (geriatric)	(n=24/54)	(n=30/54)	(n=0/7)	(n=7/7)
% of regions with lower	60%	40%	50%	50%
T-scores (non-geriatric)	(n=24/40)	(n=16/40)	(n=2/4)	(n=2/4)

Table 4. The correlations between BMI and T-scores of L1-4 and femoral neck in geriatric and non-geriatric male groups.

	L1-4 (T-score)	Femoral neck (T-score)
BMI of geriatric	r=0.459	r=0.290
male group	P=0.000	P=0.001
BMI of non-geriatric	r=0.285	r=0.236
male group	P=0.002	P=0.011

*P values <0.05 are considered as statistically significant. BMI: Body mass index

age [17]. In our study, lumbar and femoral BMD values were significantly lower in the geriatric male group. Also, osteoporosis of the lumbar and femoral regions was detected 3.5 times and 6.7 times more, respectively, in our geriatric group as compared to our non-geriatric group. In addition to age, BMI is related to BMD; for example, low BMD associated fractures are closely related to low BMI [17, 18]. Doğan et al. [19] found a significant relationship between BMI and femoral BMD measurements in geriatric men. We also found statistically significant correlations between BMI and T-scores of L1-4 and femoral neck in both our geriatric and non-geriatric groups. Specifically, our geriatric group, who had lower mean BMD measurements compared to those of our non-geriatric group, also had lower BMI, which is consistent with the studies cited above.

Though significant correlations between T-scores of lumbar vertebrae and femoral neck were demonstrated [20, 21], discordance between these two regions was also reported in many studies [9–11, 20–22], as was the case in our study. In their study with 649 males over 50 years of age, Özdemir et al. [10] reported the percentages of concordance, minor discordance, and major discordance of T-scores as 59.6%, 37.6%, and 2.8%, respectively. Mounach et al. [22] determined the percentages of concordance, minor discordance, and major discordance of T-scores among 608 male participants as 58.3%, 38%, and 3%, respectively. In their large-scale study with 4188 patients including males and females, Moayyeri et al. [11] reported the percentages of concordance, minor discordance, and major discordance of T-scores as 58.3%, 38.9%, and 2.7%, respectively. We obtained similar results in both of our study groups. We detected minor discordance in four of every ten patients and major discordance in one of every 18-28 patients. Regarding the geriatric men in our study, the percentages of femoral regions with lower T-scores in patients with minor and major discordance were higher than those of non-geriatric men. This can be explained by the tendency to have both cortical and trabecular bone loss in aged patients [10, 23]. Spondylotic changes or aortic calcifications in the elderly might also cause relatively increased lumbar BMD measurements [10].

Discordance can occur because of physiological reasons, due to disease processes such as aortic calcification; as a result of anatomical factors; because of artifacts such as metallic objects; and/or technical factors such as operator-dependent variations in the examination technique [9]. In a study including 348 postmenopausal women, Singh et al. [24] detected that lumbar BMD was lower than femoral BMD in patients with discordance. This finding and our above-mentioned result makes us consider that not only aging but also male gender might have contributed to measurement of lower femoral T-scores in discordant patients. But we think that detailed comparative studies with larger groups including both genders are needed to further exhibit the effect of male gender on femoral BMD in discordant elder patients. As a challenging issue in the diagnosis of osteopenia and osteoporosis, the problem of discordance can be solved by measurement of both lumbar and femoral regions at the same session and by taking the region with lower T-score into consideration [10]. But when we have to rely on a single region (i.e. for patients with large internal metallic fixators in lumbar vertebrae, metallic hip prostheses, scoliosis, or compression fractures of vertebrae, etc.), being aware of the significant correlation between T-scores of lumbar vertebrae and femoral neck will help us in assessing the status of the site that is unavailable for BMD measurement. On the other hand, though the percentage of major discordance is relatively low as reported in previous studies and in our study, we should also be careful not to make a false negative diagnosis in a patient with regional osteoporosis at the site that is unavailable for optimal BMD measurements, as mentioned above.

Our study has some limitations. We could not use fracture risk assessment tool (FRAX), an algorithm that has recently been introduced to assess fracture risk by giving the 10-year probability of hip fracture and major osteoporotic fracture, and that has successfully been used by Gültekin et al. [25] in postmenopausal Turkish women. In our study we excluded patients with metallic internal fixators, but we could not exclude patients with spondylosis, scoliosis, coxarthrosis and/or aortic calcifications because we could not obtain plain radiographs or computed tomography images of the patients. This might have contributed to T-score discordance in some patients. Though we used a standardized BMD measurement technique, involvement of different DXA technicians during the study period might have caused operator-dependent T-score discordance in some BMD measurements. We also could not compare our results with those of females within similar age groups to assess the effect of gender on concordance and discordance of T-scores.

In conclusion, using DXA we demonstrated that the geriatric male population had decreased BMD and an increased rate of osteoporosis as compared to the non-geriatric male population. Though the correlation between T-scores of L1-4 and femoral neck was significant both in geriatric and non-geriatric men, we also detected either minor or major discordance in a considerable number of patients; this should be taken into consideration during evaluation of DXA results.

Competing interests

The authors declare that they have no competing interests.

References

1. El Maghraoui A, Roux C. DXA scanning in clinical practice. Q J Med 2008;101:605–17.
2. Kiebzak GM, Beinart GA, Perser K, Ambrose CG, Siff SJ, Heggeness MH. Undertreatment of osteoporosis in men with hip fracture. Arch Intern Med 2002;162:2217–22.
3. Deng HW, Deng XT. Determination of bone size of hip, spine, and wrist in human pedigrees by genetic and lifestyle factors. J Clin Densitom 2002;5:45–56.
4. Bhullar IS, Roberts EE, Brown L, Lipei H. The effect of age on blunt traumatic brain-injured patients. Am Surg 2010;76(9):966–8.
5. Nguyen TV, Eisman JA, Kelly PJ, Sambrook PN. Risk factors for osteoporotic fractures in elderly men. Am J Epidemiol 1996;144(3):255–63.
6. Kanis JA. Diagnosis of osteoporosis and assessment of fracture risk. Lancet 2002;359(9321):1929–36.
7. Ho YT, Kao TW, Peng TC, Liaw FY, Yang HF, Sun YS, Chang YW, Chen WL. Role of Educational Status in Explaining the Association between Body Mass Index and Cognitive Function. Medicine (Baltimore) 2016;95(5):e2656. doi: 10.1097/MD.0000000000002656.
8. Dahnert W. Musculoskeletal system. In: Dahnert W (ed). 6th ed. Radiology Review Manual. Philadelphia: Lippincott Williams and Wilkins 2007;4.
9. Woodson G. Dual X-ray absorptiometry T-score concordance and discordance between hip and spine measurement sites. J Clin Densitom 2000;3(4):319–24.
10. Özdemir O, Yasrebi S, Kutsal YG. Elli yaş üzeri erkeklerde osteoporoz tanısında kalça ve lomber omurga T skorları arasındaki uyumun değerlendirilmesi. Turk J Osteoporos 2015;21(3):105–8.
11. Moayyeri A, Soltani A, Tabari NK, Sadatsafavi M, Hossein-Neghad A, Larijani B. Discordance in diagnosis of osteoporosis using spine and hip bone densitometry. BMC Endoc Disord 2005;5:3.
12. Van der Klift M, De Laet CE, McCloskey EV, Hofman A, Pols HA. The incidence of vertebral fractures in men and women: the Rotterdam Study. J Bone Miner Res 2002;17(6):1051–6.
13. Johnell O, Kanis JA, Oden A, Johansson H, De Laet C, Delmas P, et al. Predictive value of BMD for hip and other fractures. J Bone Miner Res 2005;20(7):1185–94.
14. Çakmak B, İnanır A, Öztürk GT. Kemik mineral yoğunluğu açısından menopoz sonrası kadınlar ile geriatrik kadınların karşılaştırılması. Turk J Osteoporos 2012;18(3):86–8.
15. Aslan A, Uysal E, Karakoyun Ö. Kastamonu ve yöresi Türk toplumu kadınlarında kemik mineral yoğunluğu değerleri. J Clin Anal Med 2013;4(3):209–12.
16. Çalık Y, Çalık AF. Kemik mineral yoğunluğunun osteoporozlu erkeklerdeki yaşam kalitesine etkisi. Turk J Osteoporos 2015;21(1):10–4.
17. Nguyen TV, Eisman JA, Kelly PJ, Sambrook PN. Risk factors for osteoporotic fractures in elderly men. Am J Epidemiol 1996;144:255–63.
18. Liu H, Paige NM, Goldzweig CL, Wong E, Zhou A, Suttorp M J, et al. Screening for osteoporosis in men: a systematic review for an American College of Physicians guideline. Ann Intern Med 2008;148(9):685–701.
19. Dogan A, Nakipoglu-Yuzer GF, Yildizgoren MT, Ozgirgin N. Is age or the body mass index (BMI) more determinant of the bone mineral density (BMD) in geriatric women and men? Arch Gerontol Geriatr 2010;51(3):338–41.
20. Park WK, Kang YH, Jo GH. The study of diagnostic results discordance analysis on BMD using DEXA. J Radiol Sci Technol 2008;31(1):25–31.
21. Choi JS, An KC, Lee CS, Choi JM, Kim JY, Shin DR. DEXA T-score concordance and discordance between hip and lumbar spine. J Korean Soc Spine Surg 2003;10(2):75–81.
22. Mounach A, Abayi DAM, Ghazi M, Ghozlani I, Nouijai A, Achemlal L, et al. Discordance between hip and spine bone mineral density measurement using DXA: prevalence and risk factors. Semin Arthritis Rheum 2009;38(6):467–71.
23. H. Chen, X. Zhou, H. Fujita, M. Onozuka, K.Y. Kubo. Age-related changes in trabecular and cortical bone microstructure. Int J Endocrinol 2013;2013:1–9. doi:10.1155/2013/213234
24. Singh M, Magon N, Singh T. Major and minor discordance in the diagnosis of postmenopausal osteoporosis among Indian women using hip and spine dual-energy X-ray absorptiometry. J Mid-life Health 2012;3:76–80.
25. Gültekin SS, Arslan MS, Topaloğlu O, Delibaşı T. Fracture risk analysis in postmenopausal women with the current methods. J Clin Anal Med 2015;6(5):541–4.

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